Conflict in the Profit-Led Growth Model

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Abstract

We model the interaction between capitalists and entrepreneurs as a dynamic game. The open-loop Nash equilibrium and the closed-loop Nash equilibrium are distinguished. The purpose is to answer some questions that have arisen in the development of profit-led versus wage-led growth models. We find that the rate of profit and the discount rate as well as the responsiveness of the wage rate or aggregate consumption to the accumulation of capital are critical to explaining the change in regimes.

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1 Motivation

Some conundrums have arisen in the development of profit-led versus wage-led growth models. We are concerned with the characterization of modern capitalism along this axis. Thus, the description of contemporary western economies as profit-led means that a fall in wages and a corresponding increase in profits entail sufficient investment demand to compensate for the expected fall in consumption demand. However, falling wage shares have not correlated with high investment (Kapeller and Schütz 2015). Furthermore, the increasing shares of profits in national income are accompanied by growing consumption. One line of attack has been launched from the position that the polarization of classes, harking back to the nineteenth century, is no longer relevant. The categories shade into each other. The typology of groups in the contemporary economy has to be reframed (Dünhaupt 2013; Kim et al. 2014; Setterfield and Kim 2014; Taylor 2014). Accordingly, workers have been divided into those on the shop floor, on the one hand, and supervisors and managers, on the other. The latter save and derive some of their income from property. They own a stock of wealth which attracts profits, interest, or rental income. Thus, capitalists in our model include the latter set of workers. The conflict in the title of the paper refers to a differential game played between them and entrepreneurs who represent capitalists in hiring workers on the assembly lines, organizing production, and selling the output. After meeting the wage bill, entrepreneurs return the residual revenue to the capitalists.

Theoretically, the tension between wage-led and profit-led models of growth arises from the combinations of coefficients in linear specifications of the Cambridge growth model. One result is that the total effect of a decline in the wage share on aggregate demand depends upon the relative magnitude of the reactions of consumption and investment demand to changes in income distribution. If the total effect is negative, the demand regime is said to be wage-led. If positive, the regime is called profit-led. Whether the negative effect of low wages on consumption or the positive effect on investment predominates is an open question (Stockhammer and Onaran 2013). We follow through with the implication that the consumption function must be investigated closely. Thereby, we counterpoise the attention given to the propensity to invest by Post Keynesians. The agenda there was given by Kalecki: "the determination of investment decisions remains … the central pièce de résistance of economics" (Kalecki 1971,

p.165). The task is to move beyond Marx's proclamation that accumulation is the law of Moses and the prophets. Consequently, scholars have been regularly experimenting with various reduced-form behavioral equations in the quest to explain investment. We revert to neoclassical micro foundations because demand (supply) functions can be generated from the same source. At the same time, the macroeconomics of the economy is represented by an accumulation of capital equation in the classical sense. Although the dynamic equation is derived from a set of standard definitions and identities, the explanatory variables include all the important elements in the non-neoclassical growth model.

In connection with the arguments of the demand functions, one aspect of the discussion has revolved around operating with historical or with forward-looking data. Put differently, the choice is between using closed-loop functions, those that depend on the state of the world, and open-loop functions, those that are information-invariant. As an illustration of the latter, political economists have borrowed notions like the 'rational (in)attention' of consumers (Cynamon and Fazzari 2013). Expectations, according to this view, are sticky. Information is not updated because it is costly to do so. Also, Post Keynesians often employ life-cycle models of consumption behavior. The life-cycle consumption plan is the solution of a problem solved once and for all in the youth of the representative agent. The consumption function is open-loop. Behavioral theories, in contrast, are closed-loop. Agents use information as it becomes available every period. Both possibilities are entertained in our treatment of the repeated game. The open-loop Nash equilibrium (OLNE) is one in which the strategies of the players do not depend upon the state of the game. A Markov-perfect Nash equilibrium (MPNE), on the other hand, is one in which the strategies of the players depend upon the information sets available at every stage of the dynamic game. We formulate and resolve the conflict below. The final section is a summary.

2   The Model and Results

2.1   Preliminaries

The following definitions are from Foley and Michl (1999).The notations are as follows: real gross product is X and the number of employed workers is N, $x =$

X/N is a measure of labor productivity and $k = K/N$ is a measure of capital intensity, $\rho = x/k$ is the output-capital ratio. $X = W + Z$, the sum of wages and profits. The average real wage is $w = W/N$ and the rate of profit is $v = Z/K$. Output is also the sum of consumption, *C*, and gross investment *I*. Consumption per worker is $c = C/N$.

Recalling the definition of investment as the growth of the stock of capital, $\dot{K} = I$, it is straightforward to combine the definitions to get the following differential equation.

$$\dot{k}(t) = v(t)k(t) + w(t) - c(t)$$

The problem of the capitalist is to choose a consumption stream $c(t)$ to maximize

$$\int_0^\infty e^{-\rho t} U(c(t)) dt$$

(The discount factor should not be confused with the capital-output ratio which was introduced only for the derivation of the dynamical equation). The entrepreneur chooses a wage stream $w(t)$ to maximize her profits

$$\int_0^\infty e^{-\rho t} \pi(w(t)) dt$$

(A common degree of (im)patience is used for convenience). We proceed to derive the equilibria of the game. The treatment is drawn from Van Long (2012).

2.2   The OLNE

The problem of the capitalist, given that the entrepreneur is playing an open-loop strategy, $w^{OL}(t)$, is solved by setting up the following Hamiltonian where $\psi(t)$ is the costate variable.

$$\mathcal{H} = U(c(t)) + \psi(v(t)k(t) + w^{OL}(t) - c(t))$$

The first-order conditions are

$$\frac{\partial \mathcal{H}}{\partial c(t)} = U'\big(c(t)\big) - \psi(t) = 0 \tag{1}$$

$$-\dot{\psi}(t) + \rho\psi(t) = \frac{\partial \mathcal{H}}{\partial k(t)} = \psi(t)v(t) \tag{2}$$

$$\dot{k} = \frac{\partial \mathcal{H}}{\partial \psi(t)} = v(t)k(t) + w^{OL}(t) - c(t) \tag{3}$$

Denote $-\frac{U''(c(t))c(t)}{U'(c(t))}$, the inverse of the elasticity of intertemporal substitution of consumption, by $\varphi(t)$.

Combining equations (1) and (2), we get

$$\dot{c}(t) = \frac{1}{\varphi(t)}[v(t) - \rho]c(t) \tag{4}$$

Similarly, we work out the state-invariant strategy of the entrepreneur, given the open-loop consumption plan, $c^{OL}(t)$, of the capitalist. The Hamiltonian (using the same symbol for convenience) with $\gamma(t)$ as the costate variable is

$$\mathcal{H} = \pi(w(t)) + \gamma(v(t)k(t) + w(t) - c^{OL}(t))$$

The first-order conditions are

$$\frac{\partial \mathcal{H}}{\partial w(t)} = \pi'\big(w(t)\big) - \gamma(t) = 0 \tag{5}$$

$$-\dot{\gamma}(t) + \rho\gamma(t) = \frac{\partial \mathcal{H}}{\partial k(t)} = \gamma(t)v(t) \tag{6}$$

$$\dot{k} = \frac{\partial \mathcal{H}}{\partial \gamma(t)} = v(t)k(t) + w(t) - c^{OL}(t) \tag{7}$$

Now, Hôtelling's Lemma is $\pi'\big(w(t)\big) = -N(t)$. Combining equations (5) and (6), we have

$$\dot{N}(t) = [\rho - v(t)]N(t) \tag{8}$$

The OLNE is the pair of functions (c^{OL}, w^{OL}) satisfying the differential equations (3), (4), and (8). The steady-state solution, $(\hat{k}, \hat{c}, \hat{N})$, is one where the discount rate equals the rate of profit and the following relationship holds.

$$v\hat{k} = \hat{c}^{OL} - w^{OL} \tag{9}$$

The equation can be read in the following manner.

Proposition 1: *Under open-loop strategies, a 'low' level of wages can exist with a 'high' level of consumption if the rate of profit or the discount rate is appropriately 'high' for a given level of investment.*

2.3   The MPNE

We consider, now, strategies that are state-dependent. The capitalist maximizes her utility function given that the entrepreneur is playing $w^{FB}(k(t))$ (*FB* stands for feedback).

The problem of the capitalist is to choose a consumption stream $c(t)$ to maximize

$$\int_0^\infty e^{-\rho t} U(c(t)) dt$$

subject to

$$\dot{k}(t) = v(t)k(t) + w^{FB}(k(t)) - c(t)$$

We write down here Hamiltonian as

$$\mathcal{H} = U(c(t)) + \psi(v(t)k(t) + w^{FB}(k(t)) - c(t))$$

The first-order conditions are

$$\frac{\partial \mathcal{H}}{\partial c(t)} = U'(c(t)) - \psi(t) = 0 \tag{10}$$

$$-\dot{\psi}(t) + \rho\psi(t) = \frac{\partial \mathcal{H}}{\partial k(t)} = \psi(t)v(t) + \psi(t)\left(\frac{dw^{FB}}{dk(t)}\right) \tag{11}$$

$$\dot{k} = \frac{\partial \mathcal{H}}{\partial \psi(t)} = v(t)k(t) + w^{FB}(k(t)) - c(t) \tag{12}$$

The difference between the earlier condition, equation (2), and the present, equation (11), is the additional term on the right-hand side of the latter. We need to characterize the derivative there. Its sign is given by the following result.

Lemma: $\frac{dw^{FB}}{dk} \geq 0$

Proof. From the implicit function theorem,

$$\frac{dw^{FB}}{dk} = -\frac{\frac{\partial \pi}{\partial k}}{\frac{\partial \pi}{\partial w^{FB}}} \tag{a}$$

We proceed to sign the right-hand side. Consider $w' \geq w$, $k' \geq k$. The profit function is convex in input prices. Consequently,

$$0 \geq \pi(w', k) - \pi(w, k) \geq \frac{\partial \pi(w,k)}{\partial w}(w' - w) \tag{b}$$

Assume that the entrepreneur is constrained in her level of capital to k. Then a relaxation of the constraint to k' increases her profit. Also, the profit function of the 'constrained' producer is strictly concave in the level of capital. Therefore,

$$0 \leq \pi(w, k') - \pi(w, k) < \frac{\partial \pi(w,k)}{\partial k}(k' - k) \tag{c}$$

Putting b and c into a, we get the result we seek. Hereafter, we denote the derivative in the lemma by $\delta(t)$. Combing equations (10) and (11), we get the following differential equation in consumption.

$$\dot{c}(t) = \frac{1}{\varphi(t)}[v(t) + \delta(t) - \rho]c(t) \tag{13}$$

We move on to the optimization problem of the entrepreneur. In the familiar manner, we derive her choice, given the state-dependent consumption plan, $c^{FB}(k(t))$, of the capitalist. The Hamiltonian, here, is

$$\mathcal{H} = \pi(w(t)) + \gamma(v(t)k(t) + w(t) - c^{FB}(k(t)))$$

The first-order conditions are

$$\frac{\partial \mathcal{H}}{\partial w(t)} = \pi'\big(w(t)\big) - \gamma(t) = 0 \tag{14}$$

$$-\dot{\gamma}(t) + \rho\gamma(t) = \frac{\partial \mathcal{H}}{\partial k(t)} = \gamma(t)v(t) - \gamma(t)\left(\frac{dc^{FB}}{dk(t)}\right) \tag{15}$$

$$\dot{k} = \frac{\partial \mathcal{H}}{\partial \gamma(t)} = v(t)k(t) + w(t) - c^{FB}(k(t)) \tag{16}$$

In the present instance, denoting the derivative at the extreme right in equation (15) by $\beta(t)$, equations (14) and (15) deliver

$$\dot{N}(t) = [\rho - v(t) + \beta(t)]N(t) \tag{17}$$

The MPNE is the pair of functions (c^{FB}, w^{FB}) satisfying the differential equations (13), (16), and (17). The steady-state solution, $(\hat{k}, \hat{c}, \widehat{N})$, is represented in the following two equations.

$$\rho + \beta(t) = v(t) = \rho - \delta(t) \tag{18}$$

and

$$v\hat{k} = \hat{c}^{FB} - w^{FB} \tag{19}$$

The derivatives in (18) introduce wedges between the rate of profit and the rate of impatience. From the lemma, the derivative of feedback consumption with respect to the level of capital, $\beta(t)$, can be signed. It is negative. Now, a 'low' real wage can coexist with 'high' aggregate consumption at a 'low' rate of profit but at a 'lower' discount rate as long as the growth of wages (with respect to the growth of capital) is 'sufficiently high' (Lavoie and Stockhammer 2012). Equivalently, the fall in consumption with respect to the growth of capital must be 'sufficiently high'. With this extension of our analysis we include other debating points in political economy. The heterodox translation of low horizons is "short termism". It is possible, then, for the rate of profit to be falling as snapshots of this economy are taken over time as long as "short termism" is increasing even faster. The counterpart of Proposition 1 follows.

Proposition 2: *Under feedback strategies, at a steady-state level of investment, a 'low' level of wages can exist with a 'high' level of consumption for a 'low' rate of profit as long as the discount rate is even 'lower' and the responsiveness of wages or consumption to the accumulation of capital is sufficiently 'high'.*

3   Conclusions

We address some questions raised in the literature on profit-led versus wage-led growth models. In response, we set up and solve a capital accumulation game. In one Nash equilibrium, where strategies are independent of the state of the world, 'low' wages and 'high' consumption coexist with a 'high' rate of profit and a 'high' degree of patience, given a steady-state level of investment. In contrast, in a

situation where entrepreneurs and capitalists monitor the state of the world period by period, if the responses of wages or consumption to changes in the state (summarized by the capital stock) are sufficiently high, 'low' wages can coexist with 'high' consumption for a 'low' level of the rate of profit as long as the discount rate is even 'lower'.

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